Using Photographic Space to Improve the Evaluation of Consumer Cameras

Risë K. Segur
Eastman Kodak Company
Rochester, New York

Abstract

When designing a camera system it is important to understand your customers, including where and under what conditions they are likely to capture pictures. This paper discusses the conditions under which consumers typically capture pictures (referred to as Photographic Space), including the camera to subject distance, primary type of light and location where pictures are taken. Knowledge of the conditions where a consumer captures pictures, which has been collected in Eastman Kodak Company over several decades allows one to optimize the design of a camera or imaging system for this consumer. This paper discusses a subjective evaluation of a small group of camera systems, illustrating how knowledge of consumer Photographic Space can produce a camera design that is optimized for typical consumer behavior.

Introduction

Photographic Space, the statistical distribution of where people take pictures, is not a new concept. This space, which is described primarily by the distance from the camera to the photographic subject, the type of light on the subject, and location of the subject were originally defined and described by Faulkner and Rice[1,2] as early as 1981. During the past two decades, Eastman Kodak Company has assembled a substantial database that describes the circumstances under which people take pictures and the problems they encounter taking those pictures. Today, we know the frequency with which pictures are taken at different distances and at different light levels, among other factors.

We have also developed new techniques, which can be used with this Photographic Space data, to aid in the design and development of new photographic products and systems. It is now possible to optimize the selection of the characteristics of a photographic system to best match customer usage patterns.

This paper describes the concept of Photographic Space and illustrates how different information can be displayed on a plot of Photographic Space. The paper also shows how these concepts can be used to aid in the design and optimization of new photographic systems.

An Introduction to Photographic Space

In its simplest form, Photographic Space can be described as a two-dimensional map. One dimension is camera-to-subject distance, expressed in feet or in meters. The other dimension is the luminance or brightness of a scene (18% gray card) being photographed expressed in footlamberts (fL) or candelas per square meter. Figure 1 illustrates one way of depicting photographic space. The upper boundary is set at 2000 fL. This upper limit represents the type of scene with the highest luminance (snow or beach scene in direct sunlight) that someone might attempt to photograph. Similarly, the right-hand boundary is defined by infinity, the greatest possible distance of a photographic subject. The other two boundaries represent the lowest possible subject luminance (0 fL) and the closest possible distance (0 ft).

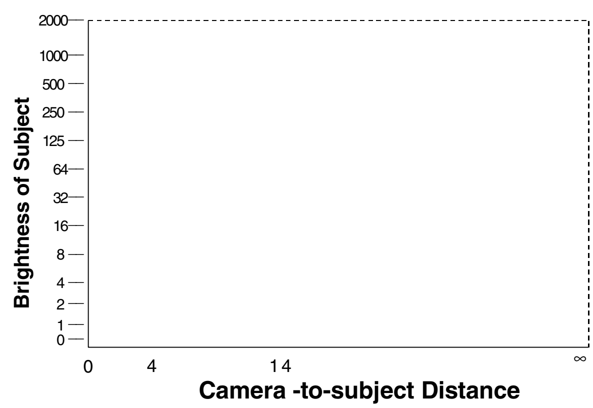

Figure 1. Photographic space

To be useful, it is necessary to display other types of information on our simple representation of photographic space. For example, it is possible to describe the capability of any photographic system by drawing lines on the photographic Space map. These lines are drawn at the limiting distances and light levels for which the system is capable of taking good pictures. The Photographic Space map, together with these limit lines, is then called System Coverage Space. Figure 2 is an example of a system with a limited focus at four feet and flash exposure range of fourteen feet.

The reader should note that this figure by itself provides an important metric for the design of photographic systems. Generally, the larger the area of system space cover, the greater flexibility a photographic system will provide the user. This, in fact, is an important metric, as many users will attempt to capture pictures outside the envelope of the System Space Coverage provided by many camera systems. Therefore, increasing this area will increase the number of acceptable pictures the end consumer will capture.

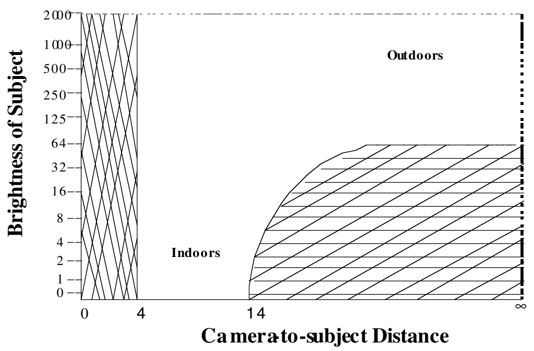

Figure 2. System coverage space

While system coverage space conveys a general idea of the amount of Photographic Space that is covered by the system, it does not provide the quantification required for optimizing a photographic system. The designer needs additional data; the most important being information that describes how frequently photographers take pictures in each segment of Photographic Space.

There are two ways of considering the frequency distribution of pictures that we refer to as Photospace. The first, and most tangible of these methods, is a three-dimensional representation of the way the target user population uses an existing photographic system. This distribution is referred to as the Photographic Utilization Space. The second method of considering the frequency distribution of pictures is a theoretical distribution of where consumers would capture pictures if the photographic system provided the ultimate flexibility. This distribution is referred to as Photographic Motivation space.

The conditions under which people take pictures are, of course, influenced by the capabilities of the photographic system that they use. One reason that very few pictures are taken at the point in Photographic Space defined by 1 foot and 1 footlambert is that most cameras cannot take an acceptable picture at that point. Because the Utilization Space is influenced by the capabilities of the system, it might be expected that systems having significantly different capabilities would have different System Utilization Spaces. Studies of the way people use their cameras have confirmed that this is the case. The distribution of picture-taking activity in Photographic Space for a person using a 35 mm Non-Single Reflex camera (NSLR) indoors is significantly different from the distribution by a person using a 35 mm Non-Single Lens Reflex Camera (NSLR) outdoors. Figures 3 and 4 show the different System Utilization Spaces for each of these conditions. It should, therefore, be noted that Photographic Utilization Space can be understood simply by understanding the conditions under which consumers capture pictures using representative photographic systems.

Photographic Motivation Space, or the frequency distribution that would exist if people had photographic systems capable of taking acceptable pictures in all areas of Photographic Space cannot be obtained directly. While this theoretical frequency space is approached as the capability of the photographic system increases, it can only be approximated by observing trends that occur in Photographic Utilization Space as the flexibility of the photographic system changes.

Regardless of the photographic space that is used, System Utilization Space and the Motivation Space are depicted in a very similar fashion. In both cases, the frequencies are depicted as a third dimension with camera-to-subject distance and illumination level on the first two dimensions of the relevant figures.

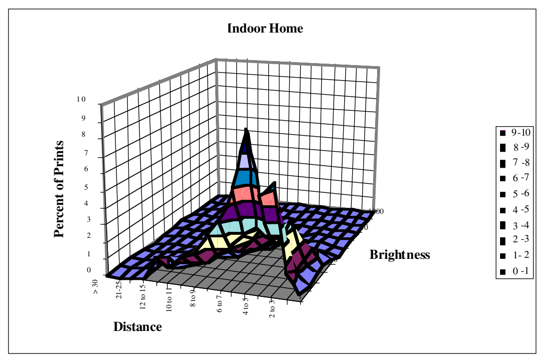

Figure 3. Photographic utilization space for a 35 mm single lens reflex camera under indoor illumination conditions.

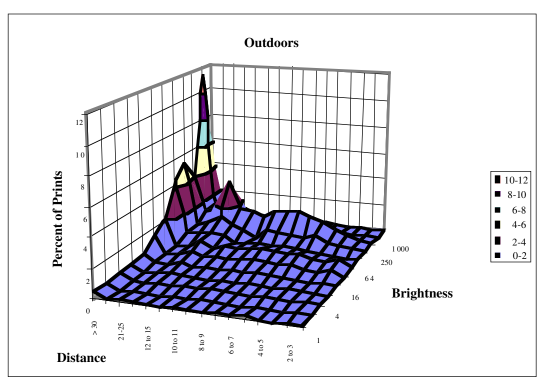

Figure 4. Photographic utilization space for a 35 mm non-single lens reflex camera under outdoor illumination conditions.

Obtaining Photographic Utilization Space

The understanding of Photographic Space provides a quantified description of the circumstances under which people take pictures, along with a corresponding description of the kinds of problems that people encounter as they take pictures. Improvements in the performance of photographic products are not meaningful unless they are realized in the hands of the consumer. The conditions under which consumers use their cameras and an understanding of the kind of problems they encounter in taking pictures are essential pieces of information when attempting to improve or optimize the overall photographic system.

Within Eastman Kodak Company, Photographic Space Information has been captured using a standardized, evolutionary process using a group of trained photographic judges and an array of instrumented devices. Images and data that is collected for this evaluation are provided through various methods, including; camera handouts, film handouts, intercepts through the company "pilot" photofinishing laboratory and Business Research handouts across the country.

The resulting databases provide a means of prioritizing the problems that occur when certain classifications of users take pictures. This usage information provides a description of the circumstances under which each photograph was made; including factors such as location, camera-to-subject distance, primary type of illuminant, subject matter, etc. It also identifies the problems that are most important to address in the development of a new photographic system. Because the databases contain a record of the picture taking circumstances for each print, it is possible to relate the problems to these circumstances. This provides valuable insight for system designers.

The database can be useful to recognize that most of the problems that degrade image quality can be organized into two classes, corresponding to two general areas of improvement opportunity. One area of opportunity continues to be extended capability, because many photographic problems occur when the photographer attempts to take a picture that is outside the boundaries of the system's capability. Another opportunity is the ease of use photographic products to overcome usability issues that impact image quality such as fingers over lens, improper flash settings, etc.

"Utilizing" Photographic Utilization Space

In today's industrialized society, almost every product that reaches the market has a long history of design modifications and testing. In view of the success of these evolutionary products, one may ask, "Why do we need consumer testing?" It is always difficult to argue with success, but those of us who on the inside of industry know that this "success" is a difficult commodity to come by in today's competitive marketplace.

The consumer is more informed today than ever before. We live in an age where the informed consumer is our best customer or worst enemy. Improved products constantly raise the level of expectations for the next generation of products, and consumers communicate their experiences with a product, not just through face to face communications, but through even more effective means of communication such as Internet chat groups. Quality products that perform as advertised and perform with little variation, are now a part of the informed customer's expectation. In many cases, only through testing are we able to produce the information necessary to determine the quality of a product so that we can predict and respond quickly to consumer reactions to our products.

At Kodak, we differentiate between three methods of verifying that a product design will meet or exceed consumer expectations. We refer to these test methods as peak capability, capability, and performance testing. Each of these test methods is useful in an evaluation. However, as listed, they seek to provide increasing validity when trying to predict system performance in the marketplace when used by a consumer population.

Peak Capability testing refers to a process that is used to evaluate a system when the system is used under ideal conditions. This type of evaluation allows one to assess the quality of the best photograph that the system is capable of producing. Under certain circumstances, this design point may be important. However, this measure typically has little value to the typical consumer, because they wish to acquire a large number of high-quality photographs under a wide range of photographic conditions, not simply a very good photograph when they use the system under these ideal conditions.

Capability testing refers to a process that is used to evaluate a system under a range of photographic conditions that represent the range of conditions under which photographs are taken. However, this study does not consider the interaction of the user with the system. In this type of evaluation, the Photographic Utilization Space data is used to determine the likelihood that consumers will take pictures under different photographic conditions. These probability distributions are then used to either select photographic conditions to be evaluated or weight the outcome of the results of an experiment. When conducting this type of test, controlled psychophysical experiments are conducted to look at the total capability of the system without the interaction of the user. Through this process we are able to identify sources of failures in the system that result from significant limitations in system capability. Further, because we have control over the entire photographic system we can isolate failures and use this information to improve the quality of our product.

In these evaluations, knowledge of Photographic Utilization Space is critical to identify representative scenes to capture for the controlled experiments. The new product, along with any benchmark products, are used to capture the same scenes identified in Photographic Space. It is important to include the wide range of photographic space and system coverage space to insure that the system will perform well in the hands of the consumer who will undoubtedly use it under a broad range of photographic conditions.

Performance testing refers to a process in which the photographic system is placed into a real-world environment. For example, early production cameras may be handed out to a representative group of users for a limited period of time. During these evaluations, the users are encouraged to use the cameras as their own and take meaningful pictures.

Once the pictures are available, the user is asked to evaluate the pictures for overall quality. The same pictures are also evaluated for usage and problems through a standard evaluation methodology. Because most camera program timelines do not allow us to collect usage and performance data over a year, knowledge of photographic utilization space used weight usage and problems appropriately to reflect the seasonal effects for specific users and camera types.

Summary

The preceding paragraphs have shown how knowledge of where people take pictures is used to derive a better understanding of the amateur photographer. The preceding paragraphs also describe three methods Kodak uses to make use of data driven decisions, based on the consumer needs and behaviors. Performance testing puts the camera in the hands of the user. Capability testing looks at the total system coverage for possible system failures. Finally, peak capability testing looks at the best quality the systems is capable of producing. Our goal is to make picture taking an enjoyable experience for our consumers.

References

1. Faulkner, T. W. and Rice, T. M.: "A Description of Photographic Space,," Eastman Kodak Company, Dept. PS, 343 State St., Rochester, NY 14650, 1981.
2. Faulkner, T. W. and Rice, T. M.: "The Use of Photographic Space in the Development of the Disc Photographic System, Proceeding of the Journal of Applied Photographic Engineering, 36th Annual Meeting, Volume 9, Number 2, April 1983, pp. 52 – 57.